

June 23, 2005

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Dear Madams and Sirs:

This letter provides preliminary findings from the Expert Review Panel (Panel) on the reasonableness of the technical analysis supporting recommendations made by Sound Transit staff on the Regional Transit Long-Range Plan.

Although the Panel's focus is ultimately on the Phase 2 transit investment strategies (ST/2), we are submitting this interim report now because the Sound Transit Board will be considering changes to its current Long-Range Plan in June of 2005 that could affect the scope and number of alternatives that might be eventually considered in the ST/2 analysis.

In addition, it seems likely that the general approaches and assumptions used in the analysis to date will serve as the foundation for the analysis that will be used in ST/2. The Panel thought it would be timely to provide you with our comments and observations at this point in Sound Transit's decision process.

### **Key Findings**

The following provides a brief summary of our findings:

- The methodology used to forecast population and employment is reasonable and serves as a defensible basis for transit planning.
- The travel demand model used to forecast transit ridership is similar to those used in other metropolitan areas, with similar variables, parameters and model specification. The Panel has raised some questions concerning certain inputs into this model, relating to such things as use of parking cost variables and the relative speeds for the modes being considered in individual corridors. Both have important influences on overall transit forecasts.
- Sound Transit has generally made reasonable assumptions concerning system integration issues, i.e., access to transit stations and connections to other transit modes. However, the Panel has noted some issues that are of interest, including a suggestion that when examining the impact of modal options in the I-90/East King County corridor, Sound Transit might want to consider total transit ridership across Lake Washington as one of the factors in its deliberations. In addition, the Long-Range Plan and the ridership forecasts assume that Northgate is a terminus for rail operations in the near-term. This is an important assumption for the ridership forecasts, but the Panel is unable to judge whether it is an appropriate assumption (as it is really an issue of funding availability).
- The methodology to develop order-of-magnitude cost estimates for the Long-Range Plan is appropriate for this stage of planning, although the Panel notes that further engineering will be required to develop higher confidence in the cost estimates. During its deliberations, the Panel questioned the assignment of costs of the I-90/I-405 interchange reconstruction for the bus rapid transit (BRT) alternative. We are pleased to note that a new cost allocation for that intersection has been developed.

### **Background**

As you know, the Panel's charge is defined in Washington State law. RCW 81.104.110 provides that the purpose of the Panel is:

“[t]o assure appropriate system plan assumptions and to provide for review of system plan results, an expert review panel shall be appointed to provide independent technical review for development of any system plan which is to be funded in whole or in part by the imposition of any voter-approved local option funding sources enumerated in RCW 81.104.140.”

In keeping with that charge, members of the Panel reviewed numerous documents provided by Sound Transit, the Washington State Department of Transportation (WSDOT), the Puget Sound Regional Council (PSRC), materials provided by the general public, and various regional newspaper articles. Panel members held several conference telephone conversations with Sound Transit staff and outside experts exploring various matters. The Panel held two, two-day meetings in Seattle, open to the public, consisting of presentations by Sound Transit staff and outside experts, as well as a tour of much of Sound Transit's service area, including construction sites for the Link light rail and Regional Express bus service, and the Monorail Green Line route. Members of the general public provided their comments to the Seattle Panel on several occasions. The Panel also received written and electronic comments from the general public.

Thus far the Panel has received briefings on the Draft Supplemental Environmental Impact Statement (EIS) for the Long-Range Plan, the ridership forecast model used to generate ridership forecasts for the Long-Range Plan, and eleven issue papers developed by Sound Transit staff that were part of the Long-Range Plan update.

We want to thank Sound Transit staff for providing us in a timely and cooperative manner with the information requested. Our deliberations have benefited greatly from their responsiveness. We also want to thank the WSDOT staff for the strong support they have provided our deliberations.

## **Analysis**

Expected transit ridership and likely construction/operations costs associated with different transit strategies are two important factors used to make investment decisions. The technical reports that have laid out the basis for these estimates vary in level of detail and by organizational sponsorship. In most cases, the reports are based on analysis conducted by Sound Transit staff. However, other organizations conducted some of the analysis. Thus, the level of depth underlying the technical analysis varies by topic.

The Panel has focused on four elements of the transit technical analysis process that strongly influence the reasonableness and appropriateness of the results. These elements relate to the approaches/assumptions/methods used in four areas: (1) ridership forecasting; (2) cost estimation; (3) network integration/alternatives definition; and (4) engineering feasibility.

The following sections describe briefly our observations in each area.

### **1. Ridership Forecasting**

Three aspects of ridership forecasting are important foundations for defensible estimates -- population/employment forecasts, specification of the ridership forecasting model itself, and the manner in which different technologies are represented in the modeling approach. Each can have important influences on resulting ridership estimates.

#### A. Population/Employment Forecasts

The most important inputs for future ridership estimates relate to the PSRC forecasts for population and employment in the transit service area, which include both the overall magnitude of population and employment increases, and the spatial distribution of this new growth. Put simply, where one assumes new population and employment to occur in the Puget Sound region will have a very significant influence on expected transit ridership. By the very nature of forecasting, it is very difficult to confirm or dispute the numbers by themselves in that any future-oriented prediction is based on underlying assumptions of what the world will be like 25 or 30 years from now. We used a very simple rule-of-thumb to determine the reasonableness of the population and employment forecasts--the ratio of the two. Dividing employment by population provides an approximation of the proportion of the population that is in the labor force (although we realize some may have multiple jobs). The ratio in the Seattle area forecasts is projected to rise to 0.559 by the year 2030 from an already high base. This trend conforms with the recent experience in the Seattle-area over the last decade. However, this recent trend in the Seattle area contrasts with the trend in most metropolitan areas where the current comparable ratio is lower than that in the Seattle area and where the ratio has been declining over the past decade.

Whether the forecast ratio is too high, and thus a source of concern, was a matter that we investigated. First, a review of previous Seattle-area forecasts over the last few decades reveals that the region has a history of underestimating employment. If this pattern holds, then the ratio may be unusual, but accurate - and ridership forecasts may even understate the number of riders. Second, if the ratio cited above is too high and the employment projection is correct, then the population projection is too low (each job would support more people). A higher than projected population should also result in more transit riders.

In summary, while Seattle's employment ratio may be unusual when compared to other cities, if this unique relationship continues, then the ridership projections might in fact be conservative. Thus, given what we have seen of the PSRC population and employment forecasts, we believe that they are reasonable as a basis for the planning that is underway.

#### B. Model Specification

The model Sound Transit uses to predict future ridership consists of the same basic approaches that are found in most major metropolitan transportation planning efforts. The model component that predicts mode choice is based on parameters relating to the importance of travel time and travel cost to individual trip-makers that lead to the trade-off of whether a trip-maker chooses transit or some other mode of travel. The weights or values attached to the importance of trip time and cost in the model (as reflected in the variable coefficients) are very similar to those used in other cities. In fact, Sound Transit examined other metropolitan area models and the parameters used for these variables, and confirmed that the values used in both Sound Transit's and the PSRC's model to predict choice of mode are similar to those used elsewhere.

Another important aspect of model specification is the use of variables representing other "costs of travel" that will likely influence whether a trip-maker selects one mode versus another. The cost of parking is one of the most influential in this regard. Not surprisingly,

if the cost of parking goes up, the likelihood that a traveler will seek another means of reaching the destination also goes up. It is good practice to conduct a sensitivity analysis (that is, vary the values by a certain amount to see what happens to the ridership forecasts) on such variables to determine how critical they are to the overall ridership results. The Panel asked to see a parking cost sensitivity analysis to determine whether the assumed parking cost increases are reasonable.

Different values of the annual compounded growth in parking costs were used to gauge the sensitivity of the model. The current ridership forecasts are based on an assumed 3.0 percent annual growth rate in “parking costs,” a variable that acts as a proxy both for parking cost increases and for possible parking policies that discourage auto travel. The net result of this growth rate has been an approximate 11 percent transit share of all commute trips in 2030. The 2000 Census transit commute trip share was just over 7 percent which if this trip share were to continue into 2030, and everything else being equal, would correspond to a 0.5 percent annual growth rate in parking costs. We understand that a new travel demand model has been developed by the PSRC, which separates parking costs from other types of parking policy variables that might reduce auto travel. This new model assumes a 1.5 percent annual growth rate in just parking costs, which would result in an approximate 8.6 percent transit commute share in 2030. The net effect of the parking cost surrogate in the model used to develop the Long-Range Plan is a tendency to overestimate transit commute trips for all transit modes. It is the Panel’s understanding that Sound Transit will be adopting the new PSRC approach to how parking costs are incorporated into the demand model for analysis of the ST/2 recommendations.

The Sound Transit model was subjected to a validation process in 2002 when modeled results were compared to existing ridership counts by route/segment and by time of day. This validation indicated that the model results, which reflect the model specification and the coefficients of the model’s variables, replicated real world 2002 conditions to a large extent. Such validation exercises are important to gain a level of comfort with such a model. However, they do not necessarily imply that the model accurately reflects what may occur 20 to 25 years in the future.

The Panel also examined previous ridership forecasts for both Sound Transit’s Sounder and Regional Express Bus service and noted that the forecasts over-predicted what has actually occurred. We believe that to a large extent these historical estimations are the result of assumed modal availability and frequencies of service that were used in the analysis, but that have not materialized in actual operations. This conclusion was also supported by the recent eight-year report from the Citizen Oversight Panel.

Finally, it is important to note that the demand model used by Sound Transit has been the basis for forecasts of previous federally-funded transit projects in the Puget Sound region.

### C. Technology Representation

Given different modal options, another critical aspect of modeling future ridership is how the different modes are represented in the modeled network. Since travel time and cost are critical factors in a modeled trip decision, the assumed availability of the different modes, the average speed of each mode (which corresponds to travel time), the frequency of service

(which corresponds to average time waiting for the mode to arrive), the different ways of accessing the mode (for example, walk access, timed transfers, park and ride, etc.), and the fares, can each have an important influence on the ridership expected to use a particular transit mode. The Panel examined these aspects of the Sound Transit analysis.

We focused most of our review on the assumptions used for both the light rail and High-Occupancy Vehicle/Bus Rapid Transit (HOV/BRT) modes in the I-90/East King County corridor. One underlying assumption raised important questions that we would like to clarify before reviewing recommendations on final transit mode choices. Sound Transit staff explained that the light rail alternative for the downtown Seattle to Bellevue – Central Business District (CBD) segment would have 276 train departures per day, with the East King County line merging with the Airport Link south of downtown Seattle. At full light rail system build-out (which presumes the construction of all of the light rail lines studied in the draft Long-Range Plan), it is projected that peak period headways in the downtown Seattle transit tunnel would be 2.5 minutes (7 minute off peak). The Panel feels this operating plan assumption may be ambitious, especially when operations for a portion of the Airport Link line occur on surface streets. The Panel would expect that as work progresses to develop recommendations on ST/2 investments, the Sound Transit analysis will develop estimates for the frequencies for light rail operations in the downtown Seattle tunnel that reflect a more likely configuration of light rail build-out. We look forward to reviewing that estimate.

In addition, a key input for all modal options considered in the model is the average operating and cruising speeds that would occur over likely routes. This is also an important issue because it has been pointed to by some as a cause for concern about the assumptions underlying the analysis. For HOV/BRT, we understand that the basic concept is to provide transit vehicles with a relatively uncongested, and thus high speed movement, from point-to-point in the region. We understand that the incremental model consideration of the HOV/BRT mode is based on data that correspond to existing express bus operations on HOV lanes, and to bus operations on local streets where such operations are contemplated in the future. The “no action” alternative, for example, assumes a 29-minute peak travel time for buses in the I-90 corridor, between the Bellevue Transit Center and the International District station in Seattle, as compared to a 26-minute scheduled time, which seems reasonable given the variation in travel times due to road operations. For the future, local street operations are assumed to degrade due to increasing congestion on arterial roads. For example, for the segment between South Bellevue and the Bellevue Transit Center, such degradation goes from 11 minutes to 13 minutes, which also seems a reasonable assumption.

We also noted that even with anticipated degradation of times based on future anticipated congestion on local streets, the HOV/BRT alternative assumes a reduction in BRT travel time from the “no action” alternative of 1 minute between Rainier Avenue S. to Mercer Island, and a reduction from 8 minutes to 5 minutes between Mercer Island to South Bellevue. Based on the Panel’s experience these travel time reductions (and thus increases in average speeds) seem reasonable.

One of the confusing aspects of the speed numbers that have been reported in various forms is the differing interpretation of what the numbers mean. For example, Sound Transit produced an estimated travel time from Issaquah to Seattle of 54 minutes. However, this estimate included wait time, transfer time and travel time. It was not an actual running time

and thus cannot be compared to running times in a bus schedule. To determine whether the speeds of HOV/BRT and light rail transit (LRT) in the I-90 corridor seemed reasonable, the Panel examined the segment in this corridor between the proposed stations at Rainier Avenue S. and Mercer Island. These station locations are similar for both BRT and light rail transit. It turns out that the predicted average speed (based on expected travel time between these stations including expected delays in boarding passengers and operating maneuvers to access the station) for HOV/BRT on this link is 43 mph; the predicted average speed for LRT is 42 mph. The average speeds on this critical link in this corridor seem reasonable given the expected delays that would occur for both technologies in operation, and do not give one technology an advantage over the other.

At this point, we presume that the refinement of mode selection, including more detailed operating strategies, will occur after the approval of the Long-Range Plan update, with a more comprehensive analysis of LRT and HOV/BRT options. We understand it is not our responsibility to suggest what decisions the Sound Transit Board should make; however, based on the analysis we have seen, we believe that LRT and the BRT alternatives remain valid alternatives for further study in the I-90 /East King County corridor.

We believe it is also important to note that ridership forecasts assume that light rail transit will extend to Northgate. We understand that Sound Transit also hopes to take light rail to the University District in its first phase of construction, if sufficient funding is available. Both of these are critical elements of a rail ridership forecast. From a systems ridership perspective, assuming light rail to Northgate is important in that, as a terminus location, the Northgate station would attract many potential light rail trips from the I-5 North corridor, whether arriving by car, bus, walk/bicycle or being dropped off. The Panel has no way of judging whether the Northgate assumption, which is found in the region's transit plan, is reasonable given that it depends on funding availability. However, it does seem likely that this assumption has an important effect on light rail ridership forecasts.

In addition, the Panel noted during its deliberations that no new modal analyses have been conducted on the I-5 corridor since the 1996 Long-Range Plan. Although different routes through the I-5 North corridor have been studied, the draft plan has assumed that the mode choice recommended in the 1996 Long-Range Plan (that is, light rail) is still the recommended modal technology. The Panel has suggested that almost 10 years after the original plan was approved it would be appropriate to re-examine what has happened in the corridor as well as to look at systems connection opportunities with different modal options. For example, although Sound Transit has been operating express bus service on HOV lanes in the corridor, BRT was not a well developed concept 10 years ago, and we now know more about what can be expected from such an operation. Sound Transit has undertaken a modal feasibility study of the I-5 North corridor since the Panel's last meeting. The Panel members reviewed the scope for the study, but we have not received any findings as of the date of this letter.

## **2. Cost Estimating**

Cost estimates for the Long-Range Plan EIS and associated corridor studies have been prepared on an "order-of-magnitude" basis. The Panel was briefed on how those cost estimates were prepared and used in the Long-Range Plan update at our April 2005 meeting.

We understand that costs were generated using a combination of data sources (Sound Transit's experience to date on similar capital projects, WSDOT estimates for some unit costs, and industry data where there is no local experience, i.e., for the monorail), and that contingencies ranged from 30 to 50 percent. Once the order-of-magnitude cost estimates were developed, Sound Transit created a potential cost range of -5 percent to +30 percent for each potential project, which, at this point in planning, is appropriate and reasonable. It is important to note that these estimates are based on minimal engineering work and rely on unit costs from similar completed projects and/or construction bids for other projects. Completed engineering work for the corridor studies we reviewed with staff ranged from zero to five percent.

Engineers use contingency factors to account for uncertainty in the construction cost of future transit facilities in the absence of detailed engineering. The level of contingency included in these initial cost estimates is appropriate for the planning stage. It is important to understand, however, that although contingencies are included in Sound Transit's estimates at this point in the planning process, further engineering will be important in arriving at more accurate cost estimates. As more knowledge is gained of the specific engineering and construction conditions in each corridor, more accurate cost estimates can be made.

The Panel reviewed several technical reports relating to individual components (potential investments in different corridors) of the Regional Transit Long-Range Plan. In general at this stage of planning, these reports are based on appropriate assumptions and analysis logic. However, one cost estimate (based on minimal engineering work -- again appropriate at this stage of planning) that caught our attention was the estimate for the potential Tacoma Link Extension - West. The project as currently envisioned would be a light rail line running in street alignment for approximately six miles. Sound Transit's cost estimate ranged from \$400 to \$500 million. This project's order-of-magnitude cost estimates seem quite high based on the Panel's knowledge of actual costs of similar sized projects around the United States, although we acknowledge the alignment challenges that might occur in constructing this line.

The Panel also raised questions about the assumption that the entire costs for the I-90/I-405 interchange reconstruction should be borne by the BRT alternative. In order to make the BRT analysis comparable to the light rail alternative, the Panel felt that only the costs associated with the respective BRT operations should be included in this comparison. It is our understanding that revised cost estimates for the I-90/I-405 interchange have been developed to reflect a better understanding between Sound Transit and the WSDOT of how the costs for this interchange should be allocated in the planning phase.

At our April 2005 meeting, Sound Transit staff stated that the Panel would receive the draft cost estimating methodology report for ST/2 in spring/summer 2005. We are looking forward to receiving and reviewing this draft report, which will be an important foundation for decisions facing Sound Transit in ST/2.

### **3. Network Integration**

Transit decisions similar to the ones facing Sound Transit entail looking at proposed regional transit investments from a systems perspective. How individual transit routes and modes

connect to and integrate with other transportation modes and modal networks becomes an important consideration in determining the best overall direction for the region. At the level of analysis appropriate for a long-range transit plan, we believe that Sound Transit has generally made reasonable assumptions concerning access to transit stations and connections to other transit modes. However, there are some issues that merit note in this letter.

On our regional tour in February, Monorail officials expressed interest in considering potential long-range expansion of the Seattle monorail project in the SR 99 corridor. We note that a monorail option was not considered in the SR 99 corridor study. In the SR 522 corridor study, the high-capacity transit (HCT) line goes to 145<sup>th</sup> Street, then heads west as opposed to continuing south to 125<sup>th</sup> Street, which is a major activity center for this part of the region. The Seattle Monorail has assumed a terminus station at 135<sup>th</sup> Street in its preliminary planning for a future expansion of its Green Line route. In addition, a connection is assumed between the I-90/East King County corridor HCT service and a monorail station downtown, but the specifics of this connection were not clear, including how this connection was modeled for different HCT modes and thus different types of monorail/HCT transfers.

Another aspect of network integration is the perspective of what it is one is trying to accomplish. This is particularly important in the approach taken for presenting analysis results. For example, the Panel reviewed the predicted transit ridership by mode on I-90 and more specifically on the I-90 bridge. This is certainly an important piece of information. However, from a systems perspective, it would seem equally appropriate to examine the daily transit volumes across Lake Washington (which serves as a natural barrier between the Eastside and Seattle) with different combinations of investments on SR 520 and I-90. Sound Transit staff provided the Panel with a forecast for daily transit ridership volumes across Lake Washington for both I-90 and SR 520. This information could help determine which combination of modal investments provides the best transit ridership in that part of the region. Given the interconnectivity of any transit network, it is likely that changes in HCT in one corridor will have some effect on transit ridership in another corridor. Without prejudging which combination of transit technologies provides the greatest cross-Lake Washington transit ridership, the Panel suggests that a “cross-Lake Washington” perspective merits consideration.

However, one caveat on this perspective should be kept in mind. Federal funding is usually focused on one particular corridor. Thus, for federal review purposes one has to have a strong technical basis to show why a particular modal technology is preferred over others, which means corridor-specific ridership forecasts. This has often led other metropolitan areas to examine in very detailed ways individual corridors, often with very little regional perspective on how such investment might affect other parts of the metropolitan area. Of course, Sound Transit, in updating its Long-Range Plan, can provide an overall systems perspective. Federal guidelines do encourage an approach in which decisions consider how a particular investment affects regional trip making.

#### **4. Engineering Feasibility**

As mentioned above, as appropriate for this stage of planning, very little engineering work has been completed for most of the route and modal options. Most of the Panel’s work

assessing engineering feasibility will occur as additional work is completed to prepare for ST/2. However, the Panel did review materials and have conversations with Sound Transit and WSDOT staff regarding the use of the I-90 floating bridge for either light rail or monorail.

The Panel was briefed on the issues regarding the potential use of the I-90 floating bridge by either the light rail or monorail options at our April 2005 meeting. We learned that the WSDOT prepared an analysis on the additional weight the light rail and monorail line would place on the bridge. Based on our review of the materials and conversations with staff, the analysis appears to be reasonable. It appears that WSDOT Structural Engineers carefully analyzed the effects that light rail and monorail would have on the structure. In addition, a presentation was made regarding the operation of light rail on the bridge, including the transition section at each end. Expansion and contraction of the rail itself were taken into account as well as the effect of the movement of the bridge on light rail operations. A comparison of long-span bridge structures with rail crossings elsewhere in the world was also part of the analysis process.

The Panel expressed interest in knowing whether Sound Transit had talked with the manufacturers of the light rail cars about the operating environment on the floating bridge. Panel members are aware of challenges that other transit systems have experienced due to limitations of the transit vehicles themselves. The Panel requested that the manufacturer of the light rail cars be contacted to determine the limitations for operations on a floating bridge. Since our April 2005 meeting, Sound Transit reports that the manufacturer has provided assurance that their vehicles could operate on the floating bridge given its expected horizontal and vertical movements and the joints between segments. The manufacturer states that there will be no concern about vehicle dynamic movements even on the transition to the I-90 floating bridge, as long as track alignment is designed per the Sound Transit design criteria.

We should note that it was also mentioned that the light rail may occasionally have to shut down during more severe storms, as is currently the case with the roadway. The Panel would like a better understanding of the operational limitations for a light rail line during storms, at what point the conditions warrant limiting normal operations, and what those limitations would be.

## **Conclusion**

The Regional Transit Long-Range Plan provides the foundation for the next phase of work to create recommendations for new regional transit capital investments (ST/2). We appreciate the opportunity to review and comment on the analysis methods and assumptions used to support the Plan update process. Given the many different corridors where some form of transit investment could occur, and the different types of transit modes that could be considered, the decisions facing the Sound Transit Board in adopting a Plan update are challenging. Although the Panel has raised questions about some aspects of the analysis that supports this decision-making process, in general, the various corridor studies conducted by Sound Transit provide the Board, and the broader community, with a good foundation for considering transit options in the three-county region.

The Panel members look forward to continued exploration of several of the issues raised in this letter. As planning begins for ST/2, and more project-level analysis is completed by Sound Transit, we expect that future communications from the Panel will focus more heavily on project cost estimating, local design and constructability of proposed projects, issues related to transit operations and maintenance, and capital finance, along with any changes to the ridership forecasting model that might be made as part of the ST/2 process.

Sincerely,

Michael Meyer  
Chair, Expert Review Panel

cc: Expert Review Panel Members  
Senator Mary Margaret Haugen  
Bob Drewel, Executive Director, Puget Sound Regional Council